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The COMMON BARBERRY *and* BLACK STEM RUST

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BLACK STEM RUST is the most destructive disease of small grains. It destroys millions of bushels in the United States every year. In some years the loss from stem rust has been more than 200,000,000 bushels of small grain.

In the northern United States stem rust can not be started in the spring without the aid of the common barberry (*Berberis vulgaris* L.). When every common barberry is destroyed, epidemics of stem rust will be less frequent and less destructive, though there still will be some rust, as it may be blown up from the South.

An average-sized bush may produce more than 64,000,000,000 rust spores in a single spring. Each of these spores may affect a grain or grass plant and produce a rust pustule. One pustule contains 200,000 or more rust spores.

After being started by the common barberry, stem rust may spread to grain fields like wildfire. The rust started by a single barberry in the spring may ruin thousands of acres of grain by harvest time.

The United States Department of Agriculture and 13 States in the upper Mississippi Valley are cooperating in finding and destroying all of the common barberries in these States, all of which have laws requiring the destruction of this bush.

The common barberry has been planted as an ornamental bush or in hedges in cities and on farms in almost all parts of the North Central States.

More than 14,000,000 common barberries have been found and destroyed in the 13 North Central and Mountain States since the barberry-eradication campaign started, April 1, 1918. Many bushes still remain to be found and destroyed.

Seeds from planted bushes have been scattered widely by birds and other means. The resulting seedlings soon grow into bushes that scatter rust and also produce more seeds.

So rapid is this development of escaped bushes from planted bushes that unless eradication is accomplished in the near future the numbers may become so great that complete eradication in some areas may never be accomplished.

Barberry bushes and seedlings are found growing in groves, windbreaks, and orchards, along fence rows, in pastures, in thickets, along stream banks, in dense woods, and in swamps. There seems to be no place where the common barberry will not thrive when once established.

Barberry bushes sprout readily and are very difficult to kill by digging. They should be killed with salt unless they are growing near valuable shrubs, which also may be killed by the salt.

Twenty pounds of salt is sufficient to kill a barberry having a clump of stems 1 foot in diameter. The salt should be piled in and around the clump so that it surrounds each stem.

The Japanese barberry (*Berberis thunbergii* DC.) does not rust and need not be destroyed. It is a beautiful, gracefully spreading bush and may be planted wherever desired.

The common barberry spreads stem rust and therefore is a dangerous plant. Help your State and Federal agencies to find and destroy it.

Report any common barberries you find or know about to your State college of agriculture or to the United States Department of Agriculture.

This bulletin supersedes Farmers' Bulletin 1058, "Destroy the Common Barberry."

P.A.B

Washington, D. C. November, 1927

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THE COMMON BARBERRY AND BLACK STEM RUST[1]

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BARBERRY CAUSES ENORMOUS LOSSES

DESTROY the common barberry. This bush (fig. 1) spreads the black stem rust of wheat, oats, barley, rye, and about 75 wild and cultivated grasses.

Black stem rust is one of the most destructive grain diseases in the world and causes enormous losses to the grain growers of the United States. In 1904 and again in 1916 it destroyed almost 200,000,000 bushels of wheat in the United States and about 100,000,000 bushels in Canada. In the 10 years from 1916 to 1925, inclusive, stem rust is estimated to have destroyed about 378,000,000 bushels of wheat in the principal wheat-growing States of the upper Mississippi Valley. The total money loss probably was about $500,000,000, or about $50,000,000 a year. During the same period the rust also destroyed almost 100,000,000 bushels of oats and considerable quantities of barley and rye.

Stem rust is the greatest single hazard in growing wheat in the hard red spring wheat States. Badly rusted fields of wheat often

[1] The Office of Cereal Crops and Diseases of the Bureau of Plant Industry, United States Department of Agriculture, is cooperating with 13 of the North Central and mountain grain-growing States in eradicating the common barberry and certain other closely related species, in order to reduce losses from stem rust of grain.

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yield only 5 or 6 bushels of light, shriveled grain per acre when they should yield 20 or more bushels of good, plump grain. In many localities wheat is no longer grown because of the danger from rust. In the past, as noted, terrific epidemics have swept over vast areas, especially in the Dakotas and Minnesota, leaving a sickening trail of ruined wheat and discouraged farmers.

FIG. 1.—A bush of the common barberry. Note its tall, slender, erect habit of growth and abundant foliage. This bush carries and spreads stem rust to wheat, oats, barley, rye, and many grasses

The common barberry carries and spreads this destructive disease of grains. The rust develops on it early in the spring and then spreads directly to grain fields, or first to grasses and from them to the grain.

The common barberry bush is a menace. It is a dangerous plant pest and must be eradicated from the northern grain-growing regions. Fortunately it has been put under the ban of the law in many States.

Other kinds of rusts occur on wheat, oats, barley, and rye and sometimes cause considerable damage. They resemble black stem rust but can be distinguished by careful examination. They are not carried by barberries.

THE COMMON BARBERRY AN OUTLAW

The common barberry is an outlaw in Colorado, Illinois, Indiana, Iowa, Michigan, Minnesota, Montana, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin, and Wyoming. These States constitute the barberry-eradication area in which Federal and State agencies are destroying the bushes as rapidly as possible. The Federal Horticultural Board has decreed that rust-susceptible barberries shall not be shipped into this area. It is illegal also to ship them from one State to another within the area. The Prairie Provinces of Canada also have taken legal measures against rust-bearing barberries.

The common barberry (*Berberis vulgaris* L.) and its horticultural varieties, such as the purple-leaved barberry, are the most important and widely distributed of all the rust-bearing barberries. Some other species are discussed on page 19.

The Japanese barberry (*Berberis thunbergii* DC.) does not rust. It is harmless and need not be destroyed.

FARMERS LONG AGO CONVICTED BARBERRIES OF SPREADING RUST

For 200 years before the scientific facts regarding the relation between barberry and rust were known, many farmers were convinced that barberries spread rust. European farmers 250 or more years ago noticed that rust always was heaviest near barberry bushes. For a long time many scientists denied that barberries could spread rust. But the farmers observed the facts. They saw that rust was heaviest near the bushes and that it gradually decreased as the distance from the bushes increased. So convinced were they that the barberry was responsible for the rust that they insisted that bushes be destroyed, either voluntarily or under compulsion of law. English farmers succeeded in getting rid of nearly all of their barberry bushes without a law. In several other countries laws were passed.

The earliest barberry-eradication law on record is said to have been passed in Rouen, France, in 1660. Even in the United States the colonies of Massachusetts, Connecticut, and Rhode Island passed barberry-eradication laws before the Revolutionary War and more than 100 years before it was known exactly how the barberry spread rust. The Massachusetts law was passed in January, 1755, and provided that all barberries must be destroyed by June 13, 1760. The preamble to the law reads as follows:

> Whereas it has been found by experience that the Blasting of Wheat and other English Grain is often occasioned by Barberry Bushes, to the great loss and damage of the inhabitants of this Province.

The colonists did not get rid of all the barberries. But they observed the facts, had the courage of their convictions, and did what they could.

Many other attempts were made to destroy barberries in early times. There were always some objectors, however, which made it hard to eradicate bushes from any large areas. But the farmers per-

sisted. They knew they were right. They knew what happened, but not why. The scientists attempted to find out how the barberry could spread rust. The correct explanation was made by De Bary, a German scientist, in 1865. De Bary's results have been confirmed hundreds of times since then, so that the facts are now well known.

HOW BARBERRY SPREADS RUST

A tiny, moldlike parasitic fungus causes the black stem rust of wheat, oats, barley, rye, and about 75 grasses. There is nothing mysterious about a parasitic fungus. It is merely a type of plant which steals its food from other plants. That is what the term "parasitic" implies.

The stem-rust fungus has no true leaves, stem, or roots. It consists of a much-branched growth of very slender, almost colorless tubes so small that they can not be seen unless greatly magnified. The entire growth of a single fungus is called a mycelium. Each branch or tube is called a hypha. These hyphæ grow into the tissues of the grain plant and steal food from them. Clumps of hyphæ form under the epidermis of the sheaths and leaves of the grain plants. These clumps produce large numbers of spores. The enlarging spores cause the epidermis to break open in long, narrow spots, with thin, ragged edges like torn paper. Each such spot is called a rust pustule. Such pustules are shown in Figures 2 and 3.

Thousands of red spores, by means of which the rust fungus multiplies and spreads, are produced in each pustule. These spores are about one one-thousandth of an inch long. It would take two or three of them placed end to end to equal the thickness of a leaf of this bulletin and about 160 of them placed end to end to make a row the length of a kernel of wheat. These spores are produced in such enormous numbers in these pustules that they make up the masses of rust dust which can be seen on the rusted plants and which rises in clouds at harvest.

The rust fungus produces four kinds of spores in the course of a season. The spores of the first kind are colorless, very tiny, and inconspicuous. They are developed on the spores of the fourth kind. The second, third, and fourth kinds of spores are larger and highly colored and are produced in conspicuous spots on other plants. Each kind of spore represents a separate stage in the seasonal development of the fungus.

After the stage of the tiny colorless spores the three very conspicuous stages of black stem rust are: The yellow, cluster-cup, or spring stage, which develops only on the barberry bush; the red or summer stage, which develops only on grains and grasses; and the black or winter stage, which follows the red or summer stage, on grains and grasses. The seasonal life story of the rust is a fascinating tale.

THE STAGE OF THE TINY COLORLESS SPORES

The tiny colorless spores (fig. 4) are formed when the black or winter spores germinate on the stubble, straw, and dead grasses in the early spring, usually during rainy periods from March to as late as May. Each of the two cells of a black spore may produce a short,

thick, and jointed hypha. On each hypha usually are borne four very tiny colorless spores, which may be carried on the lightest breeze. They can infect only the barberry.

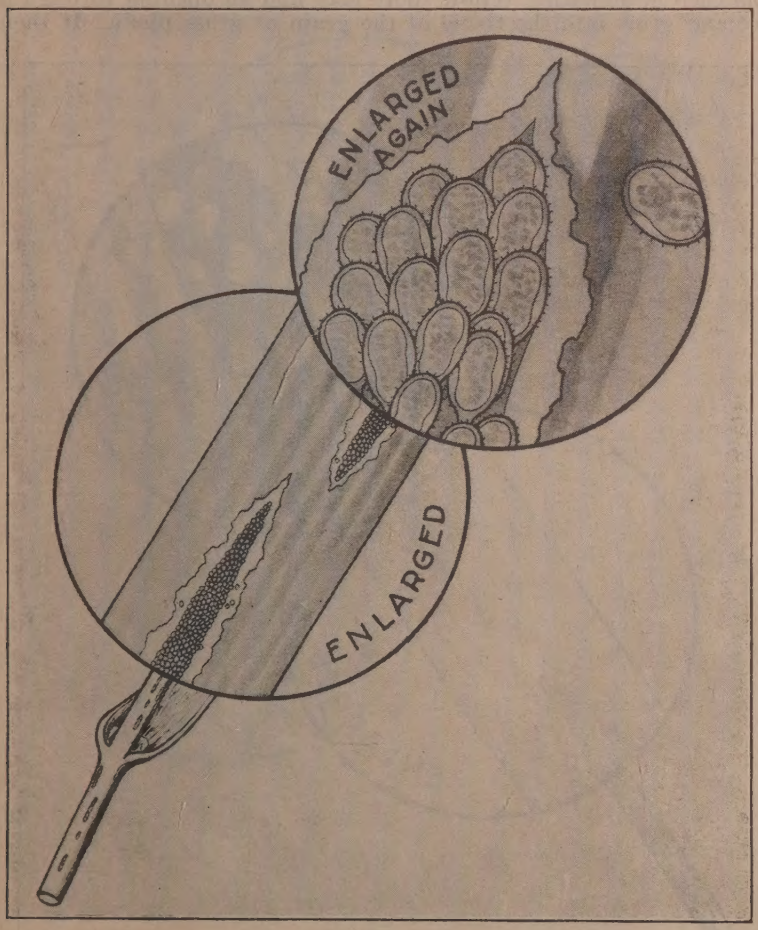

FIG. 2.—Red or summer stage of stem rust on grains and grasses, showing when magnified many oval red spores in each pustule

THE YELLOW OR SPRING STAGE

The rust fungus produces its first stage on the common barberry. This is called the yellow cluster-cup or spring stage. It forms little clusters of cups (fig. 5) in yellowish patches on the leaves, fruit, or young twigs. Each little cup contains thousands of tiny spores. These spores are shot out of the cups and scattered by the wind to grains and grasses. They can not infect barberries again.

THE RED OR SUMMER STAGE

On grain and grass plants these cluster-cup spores may germinate in water deposited by rain or dew. In a few hours the little hypha from each germinating yellow spore may find an opening through a pore and grow into the tissue of the grain or grass plant. It then

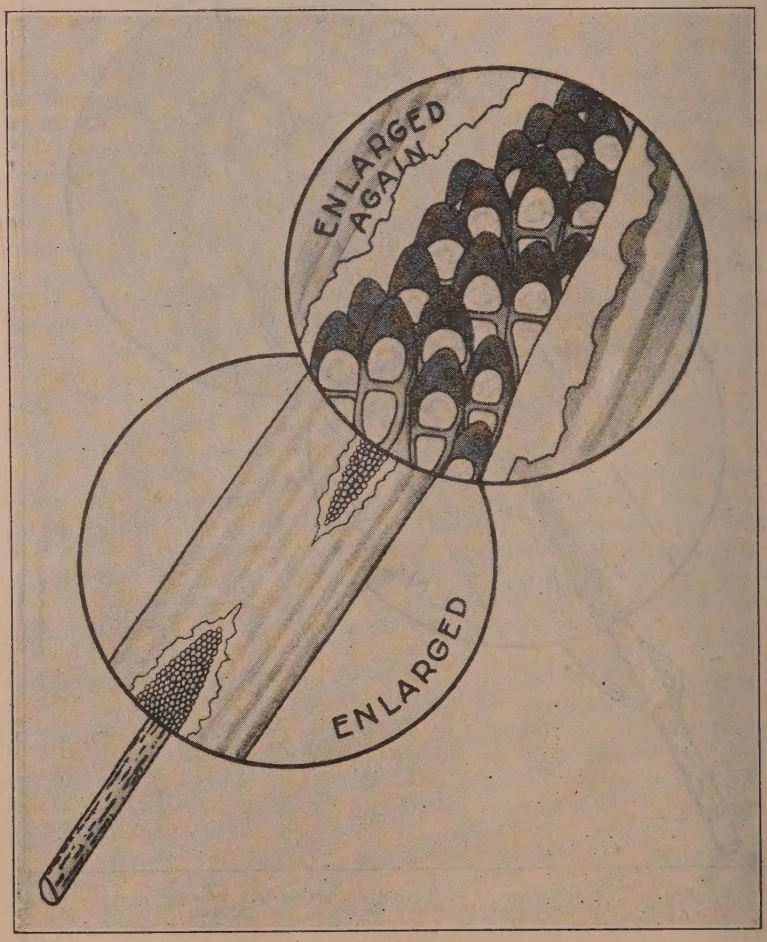

FIG. 3.—Black or winter stage of black stem rust on the stems of grains and grasses as it appears when the grain ripens at harvest time, the stage most familiar to grain growers

produces the red or summer stage of the rust. In from one to three weeks the mycelium develops so much that the pustules full of red or summer spores burst the epidermis of the plant. Each rust pustule, if magnified, is shown to contain thousands of oval red spores. (Fig. 2.) These red spores can infect only grains and grasses. Under favorable conditions they may produce by the end of 7 to 10

days more thousands of red rust pustules. These red spores can infect only grains and grasses and may continue to spread rust throughout the growing season.

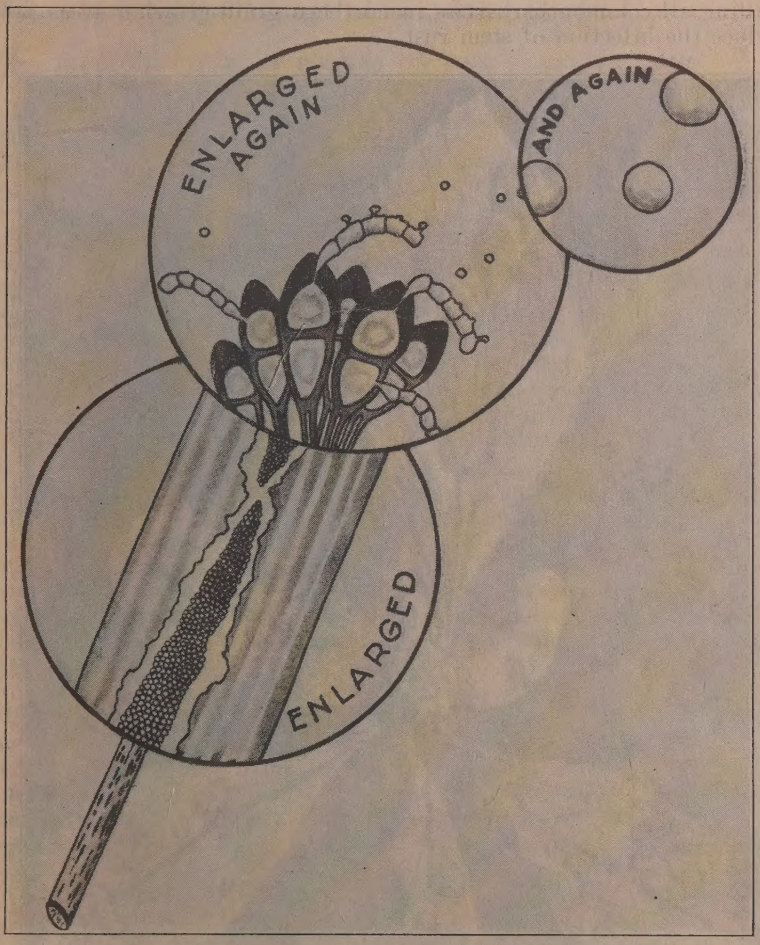

FIG. 4.—Black spores of stem rust which germinate in the spring and push out a jointed hypha on which grow tiny colorless spores. These are carried by the wind and infect only the common barberry

THE BLACK OR WINTER STAGE

As the grain ripens, the rust fungus produces the black or winter spores, both in the pustules with the red spores and in new pustules. These black spores are elongated and two-celled, and are really dark brown in color. They appear mainly on the stems and sheaths of the grain and grass plants. This is the black stem rust so familiar to grain growers. (Fig. 3.) The stem rust lives through the winter

in the black stage on straw, stubble, and wild grasses. These spores can not germinate until spring.

This completes the life cycle. It is quite evident that the stem rust can not complete this cycle in the North without the barberry. Killing all common barberries in northern grain-growing areas will reduce the infection of stem rust.

FIG. 5.—Yellow or cluster-cup stage of black stem rust on leaves of the common barberry. Each little cup contains thousands of tiny spores that spread to grains and grasses and produce the red stage of stem rust. (Natural size)

Two things should be clearly understood. First, the red spores which can infect wheat or other grains directly rarely live through the winter north of Texas. Second, the black or winter spores, which do live through the winter in the North, can not infect grains or grasses directly. In order that rust may develop in the North, therefore, one of two things must happen. Either the red spores must be blown from the far South where they live through the mild winter,

or the black spores must cause rust on barberries, from which it then spreads to grain and grasses. Occasionally rust may be blown from the South into the Great Plains area. East of the Mississippi River, however, the infection comes mainly from barberry bushes. Even a single barberry bush can spread an amazing amount of rust.

BILLIONS OF RUST SPORES ON ONE BARBERRY BUSH

How can one innocent-looking shrub spread such a tremendous amount of rust? The answer is simple. There may be between 2,300,000 and 8,000,000 spring or cluster-cup spores on a single fairly heavily rusted barberry leaf. (Fig. 5.) On an average-sized bush in southern Minnesota there were about 35,000 leaves, and it was estimated that 28,000 of them were infected. The total number of spores on this bush, therefore, was about 64,000,000,000, or thirty-eight times the human population of the world. If weather conditions were favorable, each spore could infect a grain or grass plant and produce a red rust spot within a week or 10 days. In each rust spot there would be 200,000 or more red or summer spores. Each one of these summer spores could then produce 200,000 more rust spots on grains and grasses within another week or 10 days.

Of course all of these spores do not cause infection, but it is not at all strange that rust can multiply and spread from barberries with almost miraculous rapidity. There may be 64,000,000,000 spores on a single barberry bush at one time, but the bush can produce several crops of this size during a season. As many as 15,000 bushes were found in a single county in Minnesota. Multiplying 64,000,000,000 by 15,000 gives a figure which the human mind can not grasp. The wonder is that there is not more rust. If there were only a few bushes in a grain-growing country, they still could produce unbelievably large numbers of spores. In 1925 just 82 bushes were found in Norman County, Minn. But there could have been about 5,000 billions of rust spores on this number of bushes early in June. Each one of these 5,000 billion spores could cause rust on a grain or grass plant. As there are from 2,000,000 to 3,000,000 wheat stalks in an acre, enough spores could be produced on 82 bushes to cause rust on every stalk of wheat on more than 1,500,000 acres. No wonder the barberry is a menace!

ONE BARBERRY MAY SPREAD RUST FOR MANY MILES

How far can rust spread from a single barberry bush? It is often said that the rust spreads only a few hundred yards at most, but this is not true. Hundreds of local epidemics extending from 1 to 5 miles from barberry bushes have been observed and mapped carefully in the barberry-eradication area during the last few years. Some typical examples will serve to illustrate this statement.

A large 60-year-old barberry bush was found near Alert in Decatur County, Ind., in 1922. (Fig. 6.) It had already spread stem rust to the grain fields of the community. More than 50 acres of wheat in the immediate vicinity of the bush were not even cut, and the grain from more than 200 acres in more distant fields was so badly shriveled that it was not salable after being threshed. A prospective yield of 22 bushels per acre over an area of about 50 square miles was reduced to 8.8 bushels per acre. The total crop loss traceable to this

single barberry bush amounted to at least $50,000 in the one season. This bush was destroyed in 1922. Observations made every year have revealed no stem-rust losses in the community since the offending common barberry was killed.[3]

This experience shows two things: (1) That a single barberry bush destroyed $50,000 worth of wheat in a single year, and (2) that the rust was practically eliminated after the barberry bush was killed. This in itself ought to be convincing evidence that even one barberry bush can do a tremendous amount of damage. But

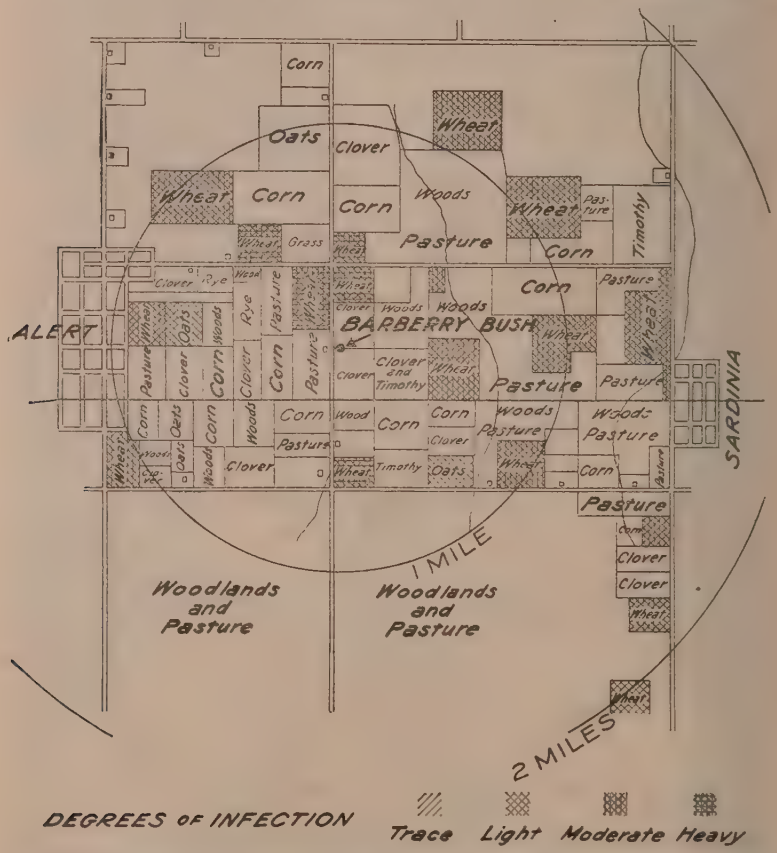

FIG. 6.—Map showing the spread of stem rust from a single common barberry bush to fields of grain near Alert, Decatur County, Ind., in 1922

there are many similar examples. The following is one of the many cases of spread of rust from barberries in Illinois:

In 1923 a cultivated hedge of 650 common barberry bushes was destroyed at Illinois City, a small town in Rock Island County. This hedge was more than 50 years old. Several escaped barberries were killed on the farms in the vicinity. The owner told the field agents that it was impossible to grow wheat on his farm because of severe stem-rust attacks. He also said that

[3] LEER, W. E. KILL THE COMMON BARBERRY. Purdue Agr. Ext. Bul. 145, 12 p., illus. 1926.

his neighbors had tried for many years to grow wheat but with disastrous results. Wheat growing on all the farms in the vicinity of Illinois City had been discontinued for several years. In some years the oats also were severely infected with stem rust when growing near barberries.[4]

Another example of the devastation caused by barberries was found in Goodhue County, Minn. A field of durum wheat was completely ruined by stem rust. (See illustration on cover page.) The grain was not even worth threshing. Winter wheat a mile away was so heavily rusted that it was practically worthless. Farmers stated that fields in this locality were always more badly damaged by rust than those in the surrounding country. The cause was evident. In a pasture adjoining the field of durum wheat there were 1,510 escaped barberry bushes. They were killed in 1922, and since that time there has been no more rust in the fields in this locality than there was in the surrounding areas.

Near Northfield, Minn., in the summer of 1922, there were 175 large heavily rusted barberry bushes in one planting. By May 26 the rust had spread 100 feet from the bushes; by June 6, more than 1½ miles; by June 12 it could be traced 2¼ miles; by June 17, 4 miles; and eventually it spread at least 10 miles from the bushes. (Fig. 7.)

Hundreds of similar cases of the spread of rust have been seen and carefully studied in Ohio, Michigan, Wisconsin, Iowa, Nebraska, South Dakota, North Dakota, and even in Montana, Colorado, and Wyoming.

In South Dakota one of the most outstanding examples of the relation of stem rust to barberries was noted near Lake Preston on the Evergreen Farms. In 1884 about 1,000 common barberry bushes were planted there, nearly all of which grew and fruited. The seeds were carried by birds and other animals to surrounding groves. Many escaped bushes grew from the seeds. In 1904 farmers of the community gathered and cut down these bushes because they were convinced that these barberries were responsible for the severe stem-rust losses. The cut-off bushes soon sprouted, and by 1917 stem rust again was found to be severe on the near-by grain fields. So evident was the relation between this barberry hedge and stem rust on the near-by grain fields that 27 farmers of the vicinity drew up and signed the following statement:

"Since the common barberry harbors the black stem rust of the wheat in the early spring and thereby starts an early and serious infection of rust, particularly because of the barberries on two farms south of town, which are known as the Evergreen Farms, where for many years early and serious stem-rust infection has been noted and is due to the presence of the barberries, we, the undersigned, believe that in order to protect the wheat crop of South Dakota from the rust infection caused by the common barberry there should be a special barberry law in South Dakota making it a crime to propagate, grow, or have growing on any public premises any of the common rust-susceptible varieties of barberry."[5]

A very striking example of the spread of stem rust from a single barberry was found in eastern Montana during the summer of 1924. A single purple barberry, heavily infected with stem rust, was growing on a lawn about 2 miles southwest of Sidney, Richland County. The native grasses immediately surrounding the bush were heavily infected with rust. The worst damage was caused in a field of Dale Club wheat belonging to a neighbor, who stated that it had been impossible to raise a satisfactory crop of wheat on that particular piece of land since 1916, owing to damage caused by stem rust. The damage caused in this field in 1924 varied from 80 per cent of the crop growing near the barberry to about 4 per cent on the outskirts of the infected area.[6]

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[4] CURRAN, G. C., and KOEHLER, B. PROTECTION OF GRAIN CROP DEMANDS BARBERRY ERADICATION. Ill. Agr. Expt. Sta. Circ. 308, 12 p., illus. 1926.

[5] BULGER, R. O. STEM RUST AND THE COMMON BARBERRY IN SOUTH DAKOTA. S. Dak. Agr. Col. Ext. Circ. 240, 23 p., illus. 1926.

[6] MORRIS, H. E., and POPHAM, W. L. THE BARBERRY ERADICATION CAMPAIGN IN MONTANA. Mont. Agr. Expt. Sta. Bul. 180, 24 p., illus. 1925.

Not only do barberries cause local epidemics but often they cause destructive regional epidemics. For instance, in North Dakota in 1924 rust was discovered over a large area. Survey showed the area to be fan-shaped. The narrow but heavily rusted handle of the fan was near Jamestown, and the rust epidemic became lighter and lighter as the fan spread out to the north, northwest, and northeast for a distance of about 100 miles. It was suggested that rusted

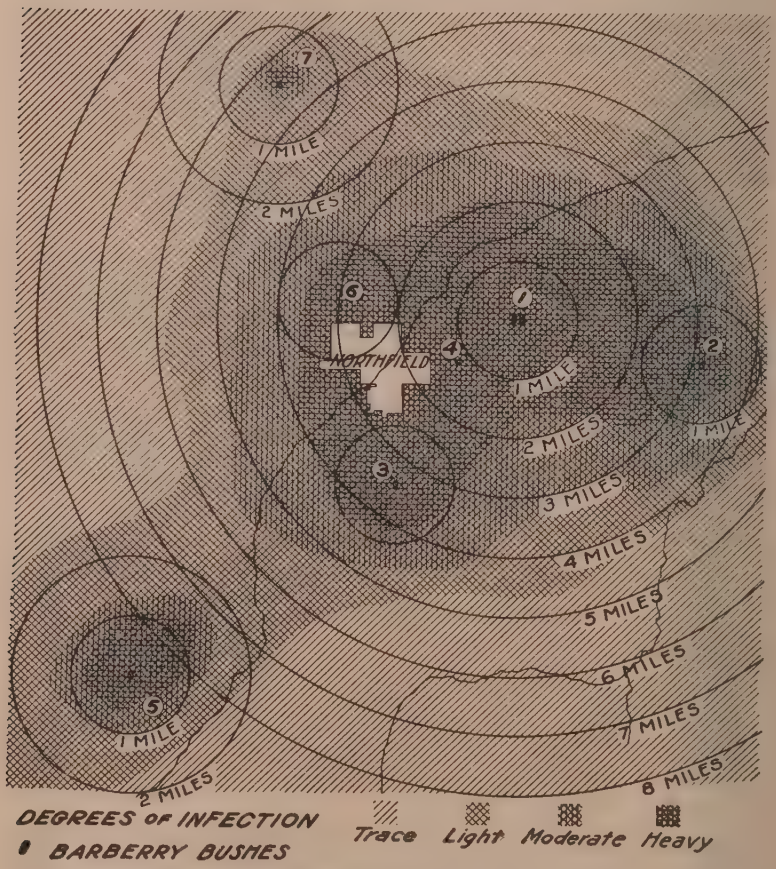

FIG. 7.—Map showing the overlapping spread of black stem rust from seven plantings of common barberries near Northfield, Minn., in 1922

bushes might be found near Jamestown. The search was made and 86 rusted bushes were found. No one suspected that they were there. The effect produced by the bushes was found first and the bushes were found later by searching near the most heavily rusted grain. The heavy rust infection near these bushes and the gradually diminishing infection as the distance from these bushes increased clearly indicated that these bushes were the cause of this widespread infection, which eventually extended northward into Canada.

The following is one of the outstanding observations made on the effect of barberry bushes in the development of epidemics of stem rust in Wisconsin:

> Records obtained during the past year [1924] show a very direct regional correlation between the infected barberry areas and regions of severely rusted grain. For example, the spread of rust from the Trempealeau County wild barberry area extended northward in a fan-shaped area over the most productive oat area in Wisconsin for a distance of about 100 miles. The infections were found within a few miles of the barberry early in the spring and spread gradually northward from these early infections until at the end of August practically all the fields in this entire area were severely infected. Fields within 25 or 30 miles of the barberry area were very severely damaged by rust, due to the early appearance of the disease. On the other hand, the region north of Dodgeville, extending to La Crosse, where the barberry has been removed, was relatively free from black stem rust on oats. It was possible to trace most of the stem-rust infection in the State directly to regions where the barberry was rusted during the early spring months.[7]

HOW BARBERRIES CAN SPREAD RUST FOR LONG DISTANCES

It may seem strange that the rust can spread as far as a hundred miles (see p. 12) from a planting of rusted barberry bushes, but this is perfectly natural. The cluster-cup spores occasionally have been caught on slides exposed from airplanes flying as high as 12,000 feet. Cluster-cup spores carried to these heights may travel a long distance and infect grain plants. It is known also that the red spores, which develop on grains or grasses near barberries, are carried aloft thousands of feet and can then be blown long distances before they come to earth again to start rust, possibly many miles from the barberry bushes near which they were produced.

It must be remembered that this is not the only way these bushes may cause rust at a distance. The rust readily spreads from the rusted bushes to near-by grains or grasses, on which the red stage is produced. The red stage of the rust then can spread directly from these grains and grasses to other grains and grasses, and in this way can continue to spread farther and farther. It is like starting a prairie fire by the sparks blown from a locomotive. Several fires may be started in an area of a few square rods. But the fire may then spread with terrific speed. The sparks start the fire. But when once started it takes care of itself. So stem rust starts from the barberry. The rust then becomes independent of the bush and does its own spreading on the grain. Many local epidemics, then, may unite to form a widespread epidemic.

Barberries can cause severe epidemics of rust in grainfields even when there is no grain at all near the bushes. The rust can spread to many grasses equally as well as to grains. Wild barley or squirreltail grass, the wild ryegrasses, quack grass, slender wheatgrass, orchard grass, redtop, bluejoint, and a host of other grasses are just as susceptible to many strains of the rust fungus as are the grains themselves. Once the rust is started on grasses near barberries, therefore, it can spread directly or indirectly to grainfields. All it needs is a start. And there are plenty of barberry bushes to give it the start.

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[7] RUSSELL, H. L., MORRISON, F. B., and EBLING, W. H. NEW PAGES IN FARM PROGRESS. Wis. Agr. Expt. Sta. Bul. 373, 99 p., illus. 1925.

MILLIONS OF BARBERRY BUSHES IN GRAIN-GROWING STATES

There have been millions of barberries in the barberry-eradication area. Since the beginning of the campaign in 1918 more than 14,000,000 bushes have been found and destroyed on about 75,000 different properties. Included in this number there were about 7,400,000 seedlings. These barberries were not only in cities and villages but also in country districts. The campaign for eradication was not started a minute too soon. In a rather small county in Minnesota there were about 13,000 bushes. In another county where small grains once were grown extensively 7,500 bushes were found. The map (fig. 8) shows the number of barberry bushes found in the States of the eradication area.

Where did all these bushes come from? The common barberry is not native to the United States. It was brought here by early colo-

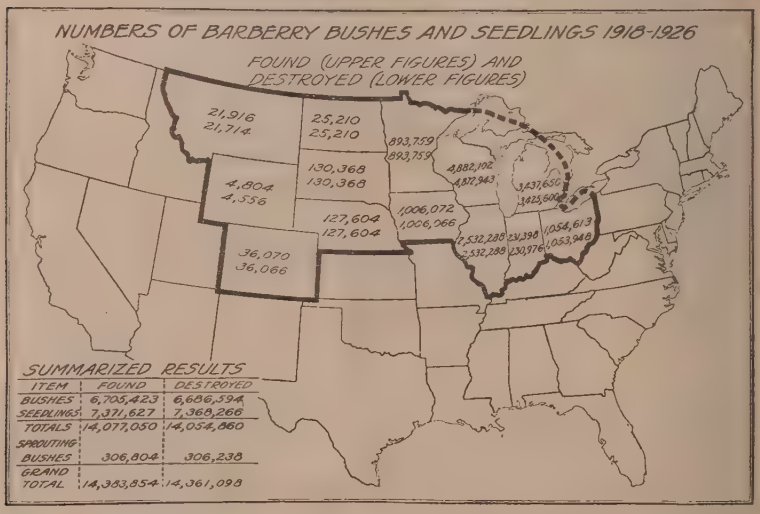

FIG. 8.—Outline map of the United States showing, by States, the numbers of barberry bushes, seedlings, and sprouting bushes found and destroyed in the 13 States in the barberry-eradication area from April 1, 1918, to December 31, 1926

nists. As people moved westward they took their barberries with them, because they used them for hedges, used the fruit for wine, jellies, and sauce, and even used the rather tough wood for rake handles and other homemade implements. Every one of the millions of bushes which have been found either was planted or has developed from seed produced by planted bushes. The common barberry produces tremendous numbers of seeds (fig. 9), which are scattered by birds, by the wind, and even by grazing animals. The number of bushes has been increasing at an alarming rate.

THE COMMON BARBERRY RUNNING WILD

In some of the New England States the barberry long ago escaped from cultivation, and there are now so many escaped or so-called "wild" bushes that it would be almost impossible to eradicate them.

It is fortunate that very little grain is grown in those States. The common barberry has not escaped to the same extent in most of the barberry-eradication States as in the New England States. It has not been grown in most of the Midwestern States as long as in New England, and the conditions for its growth in many of them are not so favorable. Nevertheless there are already large numbers of escaped bushes in the eastern States of the eradication area, particularly in Ohio, Michigan, Illinois, Wisconsin, and certain sections of Iowa and Minnesota. It also has begun to escape in the more western States of the area. (Fig. 10.)

Of the more than 14,000,000 barberry bushes already found in the barberry-eradication area, more than 4,000,000 had escaped from cultivation and were running wild on more than 8,000 different properties. In addition to these escaped bushes there were about 7,400,000 seedlings on 4,000 different properties. (Fig. 11.) This means that more than 11,500,000 of the more than 14,000,000 bushes found really were escaped bushes.

FIG. 9.—Branch of a common barberry bush, showing the shape and size of the berries. Note the abundance of berries that even a small part of a heavily fruiting bush may produce

Most of them were in the country districts rather than in cities and villages. The common barberry is especially fond of limestone soils. It has escaped from cultivation and is growing in brushy and rocky pastures, along stream banks and fence rows, on hillsides, in planted windbreaks, around lakes, and even in rather low, swampy regions. The bush grows in all kinds of locations. There seems to be no place where the common barberry will not thrive when once established. And there were countless thousands of them near grainfields.

BARBERRY THE ONLY PLANT WHICH CARRIES THE SPRING STAGE OF THE RUST

The spring or cluster-cup stage of black stem rust develops only on the common barberry and its varieties and on several other species of barberry closely related to it. It does not occur on any other native plant. There are thousands of different kinds of rusts. They grow on all sorts of wild and cultivated plants. Many of them pro-

duce a cluster-cup stage which looks very much like that of the black stem rust. But these rusts can not attack grains. Various kinds of rust are common on wild roses, blackberries, thorn apples, currants, gooseberries, sunflowers, goldenrods, asters, and hundreds

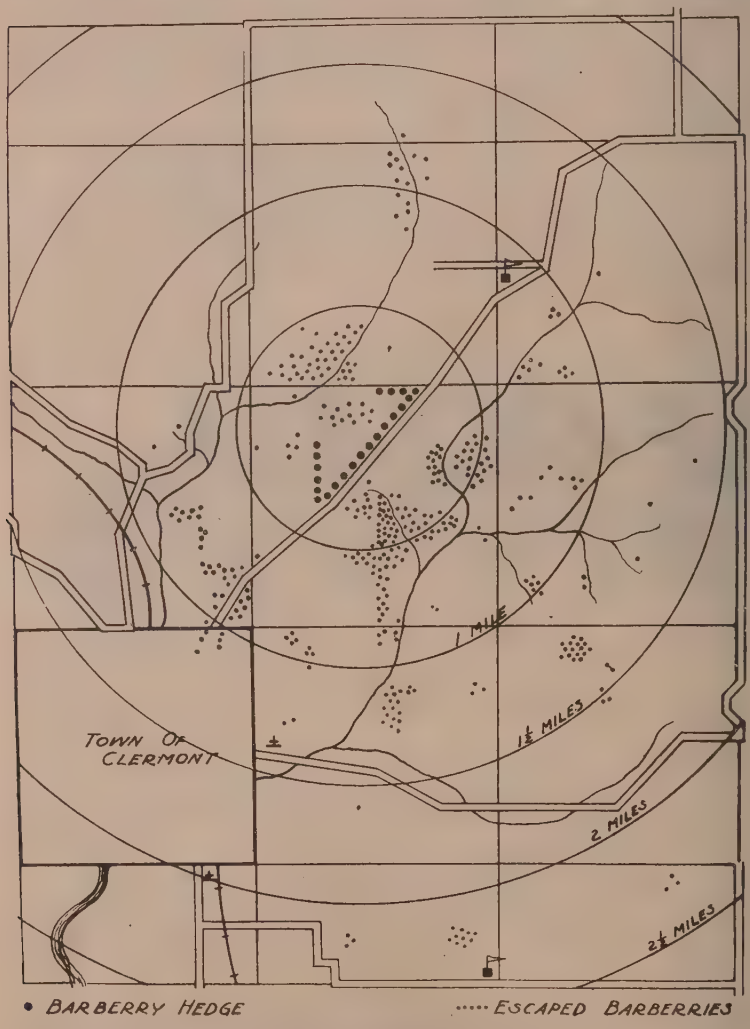

FIG. 10.—Map showing the large number of escaped common barberries (small dots) that had developed by 1926 from seeds scattered from a barberry hedge (large dots) to 11 sections in Fayette County, Iowa

of other wild plants. But all of these rusts are entirely different from the black stem rust and have nothing whatever to do with it. The black stem rust grows only on barberry bushes and on grains and grasses.

BARBERRIES RUST MOST HEAVILY IN NORTHERN STATES

Barberries rust most heavily in the Northern States. They usually rust most heavily in the barberry-eradication area, in the New England States, in New York and Pennsylvania, and in some of the mountainous districts of West Virginia and western Virginia. They also rust sometimes in northern Missouri and northern Kansas and in some of the States of the Pacific Northwest. Rusted bushes have been found as far south as Wichita, Kans., Woodward, Okla., St. Louis, Mo., Lexington, Ky., and the western counties of Virginia.

In the grain-growing portions of Texas, Oklahoma, and southern Kansas the barberry does not spread rust, because the winter spores are formed on winter wheat which is harvested in June or early

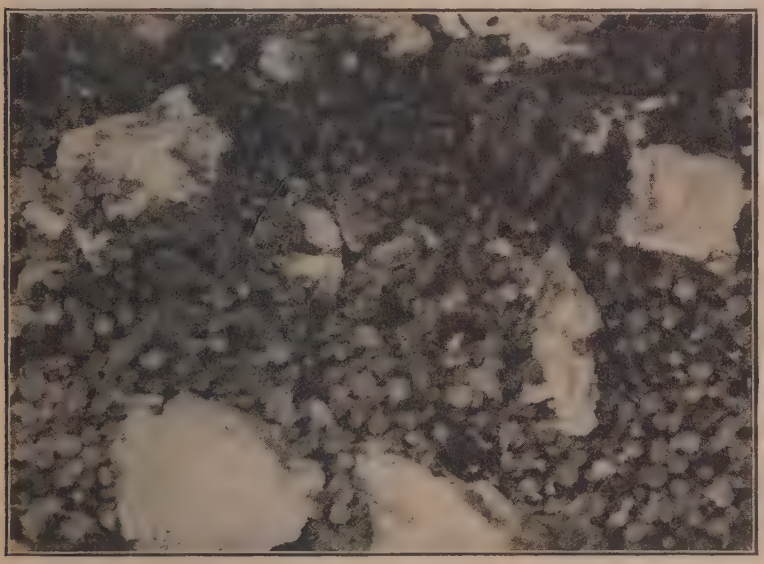

FIG. 11.—Barberry seedlings growing among limestone fragments under a cliff in Dane County, Wis. The seeds probably were carried by birds from barberry bushes in the vicinity

July. The black or winter spores can not survive the long, hot, dry summer and are dead by the following spring. In this section the summer spores often can live through the comparatively mild winter, and the rust becomes independent of the barberry. In the barberry-eradication area, however, this is not true. There the summer spores can not live through the winter and early spring to infect grains and grasses again. Therefore the barberries are extremely important in giving the rust its start in the spring.

RUST BLOWN INTO THE NORTHERN STATES FROM THE SOUTH

There are only two possible sources of rust in the Northern States: (1) The cluster-cup or spring stage on the common barberry and (2) red or summer spores on cereals and grasses in the Southern States

which may be blown northward by the wind. It is impossible to state definitely how much rust is blown from the South.

It is known that the summer stage of the rust lives through the winter near San Antonio, Tex., and other places equally far south. It seldom overwinters, however, as far north as Dallas, Tex. There is evidence that some of this rust from the South is blown into the barberry-eradication area in some years. However, it usually comes much later than rust from the barberry, and in the average year it rarely arrives early enough to do much damage. The barberry gives the rust its early start in the spring.

The bushes in the North begin to rust from the middle of April to the middle of May. Year after year the rust is abundant near barberry bushes in Iowa, Minnesota, Nebraska, South Dakota, and neighboring States before any rust can be found on grain or grasses as far north as Oklahoma and Kansas. As far north as Minnesota large numbers of cluster-cup spores are spread from barberry bushes three weeks or a month before rust appears in fields away from them. By late May and early June the rust already has spread from the barberry to grasses and grains. It is known that a tremendous amount of rust comes from the common barberry and that it comes early. It is known that if the barberries are permitted to remain and increase, a great deal more will come from them in the future. There is no excuse for keeping them. They must be destroyed.

WHY GRAIN NEAR BARBERRY BUSHES DOES NOT ALWAYS RUST

Farmers often wonder why grain is not always rusted when it is growing near barberry bushes. There are two principal reasons: (1) The weather conditions are not always favorable for the development of rust, and (2) there are different varieties of the stem-rust fungus. These varieties look alike but behave differently. For instance, there is one which causes rust on oats but not on wheat, barley, and rye. Another causes rust on wheat and barley and to a limited extent on rye but not on oats. Still another causes rust on rye and barley but not on wheat and oats. And there is still another which causes rust on timothy but not to any extent on any of the cereals; one which causes rust on bluegrass but does not attack any of the small grains; and another variety which rusts redtop but does not attack the small grains. Grain may be heavily rusted near rusted barberry bushes one year, and the grain near them may be clean the next year, although the bushes again may be badly rusted. Suppose, for example, that oats were grown near barberry bushes during the summer of 1926. The bushes probably would be rusted with the oat variety of rust in the spring of 1927. If wheat were sown in the field, it might remain rust free, because the oat variety of rust will not cause rust on wheat. Several different varieties of the rust often occur on the same barberry bushes, but sometimes there is only one. Even if the proper variety of rust is present the local weather conditions may not be favorable for the spread of rust.

WEATHER AND RUST

There is a direct relation between weather and the development of rust. The minute rust parasite can thrive only when weather condi-

tions favor its growth, just as wheat and corn can thrive only when weather favors their growth. Rust spores need moisture for germination, just as do corn and wheat seeds. Even after the rust spores have germinated and the rust parasite is inside of the grain plant, it can not grow rapidly and produce more spores quickly unless the weather is warm and muggy. Plenty of moisture and fairly high temperatures, therefore, are necessary for the development and spread of rust. Cool weather, whether dry or wet, and dry weather, whether hot or cold, checks the development of rust.

Because this close relation exists between weather and the development of rust, many persons have erroneously believed that rust is actually caused by weather. This is no more true than that the corn crop is caused by weather.

HARMFUL AND HARMLESS BARBERRIES

The common barberry (*Berberis vulgaris* L.) and its varieties and also some closely related species are subject to stem rust. The bushes are directly responsible for the spread of this disease to grains and grasses. The common barberry (fig. 12) is a woody shrub, averaging about 4 to 5 feet but varying from 3 to 12 feet in height. The bark on the older shoots is gray; the inner bark and wood both of shoots and roots are bright yellow. The leaves, borne in clusters, are round at the tip and have bristle-toothed edges. Both the green-leaved and purple-leaved varieties spread rust. The spines grow outward from the stems just below the leaf clusters. They are usually three-pointed, but sometimes have five or more points. The flowers are small and yellow. The oval berries are borne in currantlike clusters and turn bright red in autumn. They often hang on the bushes throughout the winter, becoming dark red and sometimes shrunken.

Some of the other species and varieties of barberries, however, are not subject to stem rust. The Japanese barberry (*Berberis thunbergii* DC.) is the most popular of the ornamental kinds which never rust. Both the green-leaved and the red-leaved varieties may be grown with perfect safety because they have never been known to rust. The Japanese barberry (fig. 12) is a low-spreading shrub, seldom more than 4 or 5 feet tall. The bark is reddish and the small spines usually are single, sometimes in threes. The leaves are rather small and have smooth edges; the flowers and berries are borne singly or in small bunches of two, three, or four. In the fall the berries turn a very bright glossy red, and they remain on the bushes throughout the winter.

ARE NATIVE BARBERRIES A MENACE?

The common barberry is not native to the United States, although it has escaped from cultivation in some regions. There are two kinds of native barberry in the United States which do rust, namely, *Berberis canadensis* and *B. fendleri*. *B. canadensis* grows wild in the mountains of West Virginia. Virginia, and North Carolina. It also has been reported from a few localities in Indiana and Illinois and in the Ozark Mountains in Missouri. It is very subject to rust and has caused severe losses in West Virginia and Virginia. In

FIG. 12.—The common barberry (above), harmful, and the Japanese barberry (below), harmless. Note the characteristic differences and learn to tell them apart

fact, the farmers in some of the western counties of Virginia are attempting to eradicate it. *B. fendleri* grows in the mountains of southern Colorado. It, too, may rust, but it is usually so far away from grain fields as to be unimportant.

Several species of Mahonia, closely related to the barberry, also grow wild in the Western and Southern States. One of these, the tall Mahonia, or Oregon grape, *M. aquifolium*, has been grown as an ornamental shrub. It sometimes rusts, especially the berries and young leaves, and it should not be planted. The small trailing Mahonia, *M. repens*, which is common almost throughout the Rocky Mountain region of the United States, including the Black Hills, is immune from black stem rust and has nothing whatever to do with it. It carries the cluster-cup stage of some native grass rusts, but has no relation whatever to the black stem rust. This shrub grows within the barberry-eradication area, especially in Montana, Wyoming, the Black Hills of South Dakota, western Nebraska, and Colorado. But it need not be feared. It is immune from black stem rust. There also are several susceptible species of Mahonia in the Southwestern States, but as barberries seldom rust in the South they are not important.

BARBERRY ERADICATION IN THE UNITED STATES

The barberry-eradication campaign in the United States was organized during February and March, 1918, by the Office of Cereal Crops and Diseases in the Bureau of Plant Industry, United States Department of Agriculture, in cooperation with 13 North Central and Mountain States, namely, Colorado, Illinois, Indiana, Iowa, Michigan, Minnesota, Montana, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin, and Wyoming. Three main phases have developed. They are survey and eradication, education and publicity, and investigation.

The survey and eradication activities were begun in April, 1918. This phase comprises surveys of every property in practically the entire area. Unsettled and arid parts are excepted. An attempt is made to locate and destroy every bush and seedling of the common barberry. Resurveys are conducted to see that sprouts, scattered barberry bushes, and seedlings are found and destroyed. Seedlings may develop from seeds that lie dormant in the ground for a few years after fruiting bushes are destroyed. Complete eradication is necessary to the success of the undertaking.

The first survey is almost completed. A second and more intensive survey is in progress. Necessary resurveys for destroying sprouts and seedlings also are in progress. These resurveys will be conducted as frequently as necessary to prevent sprouts and seedlings from developing.

Education and publicity involve the use of publicity materials such as newspaper articles, bulletins, circulars, form letters, post cards, posters, and cartoons. In addition, use is made of field demonstrations, exhibits at fairs, window displays, radio talks, and talks in schools, at meetings of farmers, and before organizations of business men. Education of the youth in schools and colleges is

being undertaken. Efforts are made to have lessons on black stem rust and the common barberry incorporated into textbooks and in the regular study courses of public schools and colleges. Classroom and laboratory materials for teaching are supplied directly to the schools to be used in connection with the presentation of these lessons.

Investigations include: (1) The study of the spread of rust from barberries and the locating of barberries through finding of local epidemics of stem rust; (2) the study of the spread of rust from the South; (3) the growing and classification of various barberries now found in the United States or that may be introduced; (4) the study of the susceptibility of these barberries to stem rust.

MILLIONS OF BARBERRY BUSHES ALREADY DESTROYED

Since the beginning of the barberry-eradication campaign in 1918, more than 14,000,000 barberry bushes have been located and destroyed. Attempts were made to destroy all of them as found. However, many of them sprouted when they were improperly dug and many seedlings appeared after the bushes in a given area had been destroyed. Furthermore, it was found that there are more escaped barberry bushes along streams, on bluffs, in woods, in ravines, on rocky hillsides, along fence rows, in windbreaks and wood lots, in pastures, and even in swamp lands than anyone had suspected. It is difficult to find the bushes in such locations. Planted bushes have been found in many out-of-the-way places, on long-abandoned farmsteads, in old cemeteries, and in old junglelike windbreaks. Many of the bushes have been traced because of the development of local rust epidemics near them. Many more have not been found. The cooperation of everyone is needed in order to find and eradicate the bushes and seedlings that remain. Certain areas are relatively free from barberries.

What has been the result of the destruction of these 14,000,000 barberries?

BARBERRY ERADICATION HAS REDUCED RUST LOSSES IN THE UNITED STATES

The results of barberry eradication carried out during the last few years in the United States show conclusively that this work has reduced materially black stem-rust losses.

It is perfectly clear that destructive outbreaks of stem rust almost never occur in the States east of the Mississippi River and north of the Ohio except near barberries. In general, the land surface of these States is rolling. Some native timber and many wood lots are to be found. The wind sweep is not great. Very little stem rust is blown into this area. Stem-rust epidemics usually are confined to localities near infected barberry bushes. It has been shown clearly that the eradication of common barberry bushes from this area will solve the stem-rust problem.

In the prairie and plains States the land is much more level and timber is relatively rare. The wind sweep is correspondingly greater

and the chance of rust spread is increased. But even here the barberry-eradication campaign is having its effect. Stem rust of rye already has become rare, and the complete eradication of the barberry probably will eliminate this rust almost entirely from the barberry-eradication area. In spite of the fact that there was considerable rust on wheat in 1925 and 1926, it did less damage than it did in earlier years when there were many millions more of barberry bushes than there are now. The destruction of some 7,000,000 bushes larger than seedlings, each one capable of producing at least 64,000,000 spores, certainly has had its effect. This is evident from the following figures:

In 1916, before the barberry-eradication campaign began, stem rust destroyed approximately 61 per cent of the wheat crop in Minnesota. In 1918 the barberry-eradication campaign was started. Stem rust destroyed about 20 per cent of the wheat crop in Minnesota the next year; in 1920 about 30 per cent, in 1923 about 15 per cent, and in 1925 about 12 per cent. In North Dakota the loss in 1916 was 70 per cent, and from 1919 to 1923, inclusive, it ranged from 10 to 20 per cent, while in 1925 it was estimated at 5 per cent. The loss in South Dakota in 1916 was 64 per cent; in 1920 it was 20 per cent; in 1921 and 1923, 10 per cent each; and in 1925, 7½ per cent. It seems fairest to compare the figures for 1916 and 1925 because the weather conditions in 1925 were just as favorable for the development of rust in many sections as were those in 1916. The effectiveness of barberry eradication may be more readily understood when a loss of 61 per cent in Minnesota in 1916 is compared with a loss of about 12 per cent in 1925; a loss of 70 per cent in North Dakota in 1916 with a loss of 5 per cent in 1925; a loss of 64 per cent in South Dakota in 1916 with a loss of 7½ per cent in 1925. It is significant also that the epidemic of 1925 was more localized than that of 1916. There is every reason to suppose that if so many barberries had not been eradicated the epidemic of 1925 would have been almost, if not quite, as destructive as that of 1916, except in certain areas of the Dakotas and neighboring States, where durum wheats are grown and the hot, dry weather checked the development of rust.

The estimated annual losses of wheat from stem rust are being reduced. This is seen readily when such losses in the two six-year periods 1915 to 1920 and 1921 to 1926 are compared. The estimated average annual loss in the whole 12-year period in these 13 States is 33,169,833 bushels of wheat. The estimated average annual loss for the first six-year period—1915 to 1920—is 50,419,666 bushels of wheat. That for the second six-year period—1921 to 1926—is only 15,920,000 bushels.

Barberry eradication in these States was not begun until 1918. The cumulative number of barberry bushes destroyed at the end of the first six-year period in 1920 was 4,292,697. At the end of the second six-year period, in 1926, a grand total of 14,361,098 bushes had been destroyed. These data are given in Table 1.

TABLE 1.—*Estimated losses of wheat caused by stem rust, 1915–1926, including average annual losses for the 6-year periods 1915–1920 and 1921–1926 and for the 12-year period 1915–1926, with cumulative totals of barberry bushes eradicated, 1918–1926, in the 13 North Central and Mountain States of the barberry-eradication area*

Year	Estimated loss of wheat (bushels)	Cumulative number of barberry bushes destroyed	Year	Estimated loss of wheat (bushels)	Cumulative number of barberry bushes destroyed
1915	14,000,000		1921	19,156,000	4,548,598
1916	184,208,000		1922	18,868,000	5,411,935
1917	9,906,000		1923	33,052,000	9,379,774
1918	665,000	1,692,971	1924	6,949,000	10,634,741
1919	41,766,000	3,739,734	1925	13,205,000	11,556,209
1920	51,973,000	4,292,697	1926	[1] 4,290,000	14,361,098
Six-year average	50,419,666		Six-year average	15,920,000	
			12-year average	33,169,833	

[1] The estimated losses for 1926 are preliminary.

Seasonal differences affect stem-rust development, and there is a great variation in the damage done in different years. Too much confidence must not be placed in this trend of estimated losses. There are still many barberry bushes and seedlings scattered over these 13 North Central and Mountain States. These bushes still are sufficient in number, if they become infected early and weather conditions are favorable for stem-rust development, to cause widespread and severe epidemics of stem rust.

BARBERRY ERADICATION REDUCED RUST LOSSES IN EUROPE

Barberry eradication has prevented destructive outbreaks of stem rust in several countries of Europe. English farmers have almost entirely eradicated the barberry without the aid of a law. As a result, the rust does almost no damage. In Wales, however, there still are a great many bushes, and there the rust causes serious damage.

Denmark has proved conclusively the value of barberry eradication. By eradicating the barberries as required by the law of 1903, that country has almost eliminated black stem rust.

In Norway and Sweden barberry bushes became so abundant that it was impossible to grow small grains successfully in some districts. A barberry-eradication law was passed in Norway in 1916. There have been many experiences in Norway to show that when the bushes are destroyed destructive outbreaks of rust are prevented.

Barberries have been eradicated from most of the principal grain-growing sections of Germany, and stem rust now does very little damage there.

Many barberry bushes have been eradicated from France. In those districts in which they still remain it seems perfectly clear that stem rust is most destructive and comes earlier than in those districts from which the barberries have been eradicated.

There are so few barberries in Belgium and the Netherlands that black stem rust does very little, if any, damage there. In Italy and

Spain barberries, especially at high elevations, rust heavily and spread a great deal of rust.

It can be concluded therefore that black-stem rust does no appreciable damage in the countries of western Europe from which barberry bushes have been removed, but it is extremely destructive where there still are barberries.

OTHER METHODS OF REDUCING RUST LOSSES

Barberry eradication is extremely important, but other methods also can be used to help reduce stem-rust losses.

Spring grain should be sown just as early as possible, in order that it may ripen ahead of rust. Early ripening wheat often escapes serious injury, whereas that which ripens just a few days later may be badly damaged. In those districts where rust is likely to be destructive, early varieties should be used.

If a choice of land is possible, wheat should not be sown in low-lying pockets. Air drainage is very important, as it prevents dew and rain water from remaining on the plants too long. The longer the moisture remains on the plant the greater is the danger of rust, because the spores must have moisture in which to germinate.

Proper soil fertilization often helps to reduce losses. The kind of fertilizer to be used depends upon the type of soil. In general, however, heavy applications of nitrogen should be avoided, because excessive nitrogen delays maturity and promotes dense growth. This gives the rust a better chance to develop. Potash and phosphate, on the other hand, often enable plants to escape the most serious rust damage because they stiffen the straw and promote early maturity.

When possible, rust-resistant varieties also should be used. No general statement can be made regarding varieties because the situation differs so much in different regions. Information, however, can be obtained from State experiment stations. Much work is being done by plant breeders and plant pathologists of the United States Department of Agriculture and State experiment stations in an attempt to produce rust-resistant varieties of small grains of good commercial quality. Considerable progress has been made, and there is every reason to suppose that varieties can be obtained which will yield well, be of good quality, and be at least more resistant than most of the varieties now grown. Whether it will be possible to produce an entirely immune variety remains to be seen. All of these methods will help. But one of the best methods is to destroy the source of rust. Kill the common barberry.

KILL THE BARBERRY WITH SALT OR KEROSENE

Barberry bushes should not be dug. This method was employed early in the campaign, but it was soon found that it was hard to kill bushes in this way. Bits of the roots and rootstocks remained in the ground and new bushes sprouted from them. (Fig. 13.) Digging has been almost abandoned, therefore, except on lawns or in cases where bushes have been found near valuable trees and shrubs.

The surest way to kill barberries is by applying common salt or kerosene. Twenty pounds of common salt applied to a bush having a clump of stems about a foot across will kill it. Use more in pro-

portion for large bushes and clumps of bushes and a smaller quantity for smaller bushes. (Fig. 14.) The salt should be poured into the clump and heaped up around the stems. Some of the salt should be spread for at least 6 inches around the edge of the clump to kill all underground shoots. One gallon of kerosene also will kill a medium-sized bush, but it kills slowly. There is practically no danger that bushes properly treated with either salt or kerosene will sprout. Livestock should be kept away from the salt unless they have been getting plenty of it; otherwise they are likely to overeat and injure themselves. Salt and kerosene will kill other plants as well as the barberry. Use these chemicals carefully.

FIG. 13.—Sprouts of the common barberry. Even small fragments of roots left in the soil will sprout readily. In digging barberries, every rootlet should be removed

MANY BARBERRIES YET TO BE KILLED

Many persons insist that all the barberries ought to be killed out by this time. In much of the barberry-eradication area, however, people have been planting barberries for the last 50 or 100 years. These have escaped from cultivation and have run wild in many places. It is asking a great deal of the Government and States to undo the work of so many years in a short time. Then, too, barberry seeds may lie in the soil for several years before germinating. When a barberry survey has been made, a locality actually may be clean. But afterwards seeds may germinate, and within two or three years there may be fairly large bushes where there were none before. Consequently the campaign must be carried on for a long time in order to be sure that all of the bushes are killed.

The barberry-eradication campaign certainly is worth while. It has more than justified itself in the East Central States and is grad-

ually justifying itself even in the hard red spring wheat area, where the rust does the greatest damage. It is possible to eradicate all the barberries. Now is the time to finish the work. The job is not as big as it seemed a few years ago. If the thousands of barberries which still remain are not eradicated now, there will be millions instead of thousands in a few years. In many regions the bushes seed heavily and consequently multiply rapidly. Now is the time to kill them. It will require long and painstaking effort to get rid of all of them, or even most of them, but the job can be done. It has been done in England, in much of Germany, in most of France, in Denmark, in the Netherlands, and in other countries, and it has solved the rust problem there. But in those countries practically all

FIG. 14.—Killing common barberries with salt. Apply 20 pounds to each square foot occupied by the base of the bush. Pile the salt in and around the clump of stems so as to surround every stem. The bushes readily yield to this treatment

of the inhabitants know the barberry and understand how much damage it can do.

By all means keep up the barberry-eradication campaign. It is perfectly clear that it is solving the rust problem in the States east of the Mississippi and north of the Ohio, and certainly it has been reducing rust losses in the other sections where the campaign has been in progress.

KILL THE COMMON BARBERRY AND PROTECT FUTURE GRAIN CROPS

The common barberry must be destroyed. It will be many years before all of the barberries are killed, but in the meantime the average annual loss from stem rust seems to be decreasing. Even if barberry eradication had not reduced losses up to the present time, the campaign still would be worth while as a protection for the future.

The rate at which barberries multiply and spread is appalling. More than 14,000,000 barberry bushes have already been destroyed in the eradication area. These either were planted or were the result of seedlings from planted bushes. There were about 900,000 barberries in Minnesota, a comparatively young State; more than 130,000 in South Dakota, a still younger State; and more than 25,000 in North Dakota, where one would hardly expect to find any. A single barberry bush sometimes develops as many as 12,000 or 13,000 berries, containing as many as 22,000 seeds. Under favorable conditions each one of these seeds might produce a new barberry plant. If the barberry-eradication campaign had not been conducted, not only would there be now the more than 14,000,000 rust-bearing barberries already exterminated in this wheat-growing region, but within the next few years there would be many millions more. There will be stem rust even after all the barberries are killed, but there will be much less stem rust than there has been in the past. And if all the barberries were permitted to remain and multiply, there would be much more stem rust in the future.

You can help in this campaign by reporting the location of every common barberry you find or know about to your State college of agriculture, or to the United States Department of Agriculture. These agencies need to know the location of every barberry bush that is found. These locations are mapped so that they can be revisited and every sprout and seedling which appears later can be found and destroyed.

Kill the barberry now and help to protect the grain crops of the future!

ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE

November 10, 1927

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Director of Regulatory Work	WALTER G. CAMPBELL.
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